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This paper describes selected nonschool uses of simulation and discusses the implications of each application for education in general. Most of the applications described pertain to instruction and include the provision of an environment for exercising or practicing the application of principles or skills. Applications which are examined include (1) the use by the military of various simulator trainers, auto-instructional simulators, the Pocket Blinker and a War Wound Moulage Kit; (2) the use by the government of simulation planning exercises; and (3) the use by industry of business and management simulation games. An experiment with television-mediated simulation by a Boston UHF channel and the use of simulation in situational response testing by the American Board of Orthopaedic Surgery are also reviewed. Discussion of the implications from these applications for education includes analysis of the factors of cost of the simulation, complexity, realism, uses, and value. Forty-seven references are listed. Appended is a representative listing of "Uses of Instructional Simulation Systems in Industry, Government, the Military, and Other Non-School Uses"; information on each of the 48 items includes the name of the simulation, the designer, the target group, and a brief description. (JS)

Simulation: Status of the Field[1,2]

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A function of the increasingly complex technological world in which we live has been the requirement for better learning systems -- systems where the student is actively involved in the learning process. Such an environment is learner-centered rather than instructor-centered. In this context, it is significant that simulation be explored at this conference. With the advent of simulation, the oft-quoted axiom that learners should participate actively in instruction is given meaning and substance.

The purpose of this paper is to examine selected non-school uses of simulation. Throughout the paper, implications from these applications for education in general will be pointed out. These implications involve such factors as: (1) cost of the simulation, (2) complexity, (3) realism, (4) what is simulated, and (5) its uses and value. From this discussion, perhaps the reader will be better able to assess for himself the status of the field -- where it has been, where it is now, and where it might be going in the future.

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It should be stressed that this paper in no way attempts to survey exhaustively the many uses of simulation in non-school settings. The reader is referred to the appendix for a representative listing of non-school uses of simulation.

Most of the applications discussed pertain to instruction, and in particular, the provision of an environment of exercising or practicing the application of principles or skills. The instructional simulation systems to be examined all possess the following features:

(1) enacted or life-like responses are made to

(2) non-real-life stimulus situations that

(3) provide feedback to the student vis a vis his behavior in the on-going instructional context that

(4) offers control (cf., Twelker, 1968).

Simulation may be used for purposes other than instruction. In particular, the use of simulation in the generation of new systems or programs is important. The developmental use will be explored in the section on governmental applications.

Military Applications

Simulator Trainers

In the military, the word "simulator" is commonly associated with equipment. Often, these "machine-ascendent" simulators require a team of operators rather than just one, and are called "systems simulators." Many are multimillion dollar devices, and are mediated by an electronic computer. Some have estimated that there are over 3,000 different

types of simulators used currently by the military and commercial aviation. Expenditures on prototype simulation devices are set minimally at $27 million annually. Listed below are several names of simulators that serve to illustrate the variety of training functions served by simulation.

Simulator, Small Arms, Flash Noise
Shipboard Universal Radar Land Mass Simulator
Sonar Simulator
Submarine Simulator, Universal
Talos System Shipboard Simulation Equipment
Target Generator, Three Dimensional, Airborne Simulator
Helicopter Flight Simulation
Height Finder Target Simulation
Fire Control and Launcher Simulation
F8U-1 Operational Flight Simulator Trainer

The evolution of computer-mediated simulator trainers has been significantly speeded by groups such as NASA in its efforts to provide a training capability for manned space flights. Most of these simulators represent a sophistication of man-machine adaptive and responsive environments. Kristy (1967) describes a training environment that staggers the imagination of those who spend most of the time in front of a chalkboard talking to students. The Simutech Trainer was conceived of to train Air Force electronics technicians in a manner that provides tutorial teaching capabilities and realistic on-the-job experience. The specification of the system which Kristy describes calls for computer-controlled programed learning to integrate several types of display: (1) animated schematics, (2) textual and diagrammatic teaching material that includes quizes and branching sequences. A high-speed, quick-access, videotaped presentation system provides informal lectures, "cookbook" advice, and tutorial support for the student. All this is linked with a

simulation of an electronic system which the student is responsible for maintaining. This system, linked with the computer, senses and responds to the student's maintenance actions. Another component in the trainer system is a simulation of the "operations room" of an Air Force site. This is accomplished by a "squawk box" communication tie between the operator and the maintenance room. With this system, the student:

(1) can receive video instruction on fundamentals of electronics;

(2) can receive clarification and reinforcement from the computer-controlled programed instruction console;

(3) can practice what he has learned by performing "on the job" by means of the simulated hardware;

(4) can receive remedial help when he wishes or when the computer deems it necessary;

(5) can be quizzed on his progress;

(6) can proceed at his individual pace;

(7) can be monitored so as to inform instructors of his progress and difficulties to examine during small, live-group sessions.

From studies of the efficiency of computer assisted instruction and simulation training, it is estimated that training time may be cut by two-thirds using this equipment. If the system is implemented to accomplish electronics training in the Air Force, the cost would be about $130 million. Although this cost represents a huge sum, Kristy points out that if the trainers were capable of actually reducing training time by two-thirds, the Air Force would save a large fraction of the funds expended on training, and these savings would pay for the

system engineering, hardware development, and installation costs of $130 million in only 18 months. Thereafter, the Air Force would save in training costs up to $75 million per year.

Implications to education. The civilian application of simulator trainers is discussed in detail by Kristy (1967, pp. 118-122). In summary, several important points are made:

(1) The major area of application appears to be in large federal training and retraining program;

(2) On-the-job training seems necessary for retraining efforts, but poses serious problems;

(3) A high-efficiency training system such as the Simutech Trainer can provide simulated "on-the-job" training;

(4) The application of the Simutech Trainer to the federal programs would occur simultaneously with its application in industrial training programs;

(5) The application of the system to vocational high schools has serious problems with respect to the large capital investment required.

Regarding the last point, Kristy shows that the cost of training students in an optimal installation in six to ten different technical areas might run $450 per trainee per year, figuring a 10-year period to amortize the capital investment. This is two or three times the average investment in training students. Do the benefits or potential of such devices as the Simutech Trainer demand such expensive training? Is it necessary to build a "simulator-trainer-tutorial environment" that even senses human actions to a sensitive degree and presents "diverse, alternative

programed situations leading toward teaching and learning objectives?" Can we afford to lose a quarter or more of our youngsters as dropouts who possibly might be sufficiently motivated in such an environment to continue with their education? It is estimated that "if the present rate of dropouts continues, there will be 32 million adults without high school diplomas by 1975" (Arthur D. Little, Inc., 1968, p. 11).

Indications are that there is rising concern over the steadily widening gap between the nation's manpower requirements and the capabilities of the available manpower pool. It has been predicted that "substantial" government support for manpower development programs will continue. How much is spent for civilian institutional training and on-the-job training? It is estimated that about $286 million for institutional training and $54 million for on-the-job training is spent under funding from the Manpower Development Training Act of 1963 (Arthur D. Little, Inc., 1968, p. 12). Even if the estimated $1.3 billion expenditure of Office of Economic Opportunity funds for equipment and materials in training programs are added, the total cost would hardly exceed $1.7 billion annually, while the training costs of the Department of Defense for military personnel total approximately $4 billion per year. It should not be necessary to say more about the comparison of where "substantial" support is going!

What does the military think about simulation? The Arthur D. Little, Inc. report (1968, p. 13) states that:

> "The growing emphasis on cost/effectiveness in military training programs will result in much greater use of simulation training. NTDC personnel suggest that the use of simulation is in its infancy and that there may be almost total dependency on simulation in several training areas in the not-too-distant future. Typical areas which lend themselves to simulation techniques are

cockpit and operational flight training, in-flight training, and training in electronic warfare and weapon systems.

In order to teach personnel to operate in the conceptual, psychophysical environments of the present and those anticipated for the future, new technologies are used to simulate such environments visually. A simulator involves any one or a combination of the training environment, computing and associated simulation systems, and instructor station and display systems. Electronics and optics represent major elements in the fabrication of a simulator. However, the market is not limited to electronic and optics companies; industrial organizations having educational technology capabilities should realize a considerable share of this market."

Will the military experience in simulation be translated effectively to the education of civilians in school settings? Few simulators have been used in occupational education. The factors that preclude rapid adoption center around three areas:

Expense. Few schools have the capital to invest in these complex simulator systems, even if it were shown that training time could be drastically reduced and that the system could pay for itself in a reasonable period of time. It has been estimated that the cost to provide electronic equipment to one child per year is $250 vs. $8 per year per child for texts (Arthur D. Little, Inc., 1968).

Insufficient cost/effectiveness data. This might be the major problem with complex systems such as the Simutech Trainer in civilian applications. The very great cost advantage where high efficiency training is desired and economically necessary has yet to be proven.

Slowness of acceptance. Educators are a conservative lot, and the supposed "dehumanizing of education" poses a threat to innovation.

In fact, machine-ascendent simulation does not dehumanize instruction, but places in the hands of the student a learning environment that is quite similar to the operational world in which he will have to subsequently operate.

The Little report indicates that it will probably take fifteen years before computer-assisted instruction is accepted and used by the majority of the elementary and high schools in the nation. In 1967, only three school systems were experimenting with CAI. It is doubtful that machine-ascendent simulation will have an impact that is greater, although this writer hopes that his pessimism is unwarrented.

Auto-Instructional Simulators

In the military, simulation applications range from the exceedingly simple to the exceedingly complex. At one end of the continuum, a simulator may cost as little as ten cents, while on the other end of the continuum, one single simulator may cost as much as $11 million. The Simutech Trainer discussed above was a complex system that taught, among other things, the proper steps and procedures of trouble shooting (a cognitive objective) as well as how to actually carry out the task on the job (a cognitive/psychomotor objective). The former involves the teaching of certain decision-making skills, discrimination skills, problem-solving, and so forth. The latter involves the learner in using these skills on the simulated job which demanded physical manipulation. Although simulation may be used to exercise both types of objectives, the cost may vary tremendously. A class of auto-instructional devices termed Trainer-Tester Simulators that cover many subjects

illustrate this admirably. For illustration, a motor trouble-shooting Trainer-Tester Simulator will be examined.

At the U. S. Army Ordinance School at the Aberdeen Proving Ground in Maryland, several courses require servicemen to remove, install, trouble-shoot and adjust six-cylinder engines. One way to accomplish this is to have a series of engines rigged to exhibit certain defects, and teach the servicemen the correct procedures to use in trouble-shooting and correcting the fault. Needless to say, this is expensive, and led Van Valkenburgh, Nooger, and Neville, Inc. to design the Trainer-Tester Simulator, an auto-instructional device that uses pictorial views, and specially designed worksheets. The Pictorial Review sheets are used in conjunction with the worksheets to familiarize the trainee with the location of various components, to show the interrelatedness of the components, and to assist the trainee in determining correct procedures to be followed in performing the simulated tasks given in the problems. The Trouble Shooting and Repair Worksheet includes columns that list a specific problem, a symptom section, and a corrective-action section. The data in the symptom and corrective-action sections are concealed by a silver overlay which is easily removed by using a pencil eraser. The data uncovered reflects deviations from normal operation with the equipment operating under the indicated trouble symptom. The trainee must be familiar with the equipment to select those checkpoints from which he wishes to obtain data so that he may arrive at a correct solution. Indiscriminate erasures indicate that the trainee has analyzed the problem incorrectly.

A typical trouble shooting problem for the six cylinder engine is given as follows: "Breaking action is poor; break pedal has a soft,

spongy action." or "Engine will not start and there is no spark at the spark plugs." Using the latter problem as an example, the trainee might reason as follows:

> "Well, it's apparent that the trouble is electrical in nature. Also the fault must not be with the batteries or starting motor since the motor turns over. Hmmm - let's check Figure 17 (the wiring diagram). Most likely, the fault is with the spark plugs or the distributor. Let's start trouble-shooting at the spark plugs. (Trainee refers to pictorial reviews and part identification sheets, and finds that spark plugs are called out by the symbol letters AD. He then runs down the list of check-point symbols on the Trouble Sheeting Worksheet until he comes to the letters AD and then erases the silver overlay adjacent to the letters and writes the number "1" in the Step column.) "Got a value of '0.030 end gap.' (Trainee checks normal value on supplementary information sheet.) That indicates the spark plugs are functioning normally and that's not the cause of my trouble. The fault must be with the distributor."

The trainee has just begun on his trouble-shooting mission. He has yet to examine the breaker points, the breaker-plate capacitor, distributor rotor, ignition coil, or distributor cap. Any of these five parts could be the cause of the trouble and has to be checked until the data obtained disagrees with the normal value of the part given on a supplementary information sheet. By the way, when the student erases the silver overlay next to the distributor cap, it reveals the word "cracked" which indicates that a cracked distributor cap is a possible cause of the trouble. He then moves to the corrective action column, specifies a part replacement and finds that the trouble is corrected and the problem has been solved.

Implication for educators. Once again, the Trainer-Tester Simulator represents a low cost, but highly effective technique for teaching both identification skills and operational procedures. Note that these operations are at the cognitive level, and do not involve psychomotor skills per se. Of course, in the operational situation, the trouble-shooter

would then be required to remove engine components, replace defective parts, and so forth. Yet, the simulator effectively shortcuts an inefficient and time-consuming trouble shooting operation if real equipment were involved at early stages of instruction. It is important that the trainee know what to trouble shoot, and in what order, before he actually begins the messy business of removing engine components and the like. These skills could just as easily be performed or practiced on the job. This illustrates an important advantage of simulation: When actual on-the-job performance would be costly or hazardous, use simulation. The Trainer-Tester Simulator is inexpensive to produce and is admirably suited for the educational objectives. What better way would there be to have biology students "practice" dissection before actually beginning the work. After reading the text, they could go through the procedure using a autoinstructional Simulator. Or the technique could be applied to medical education, where medical students would be required to diagnose certain problematic symptoms of a patient. This, in fact, has been done in the area of orthopaedic surgery, and will be discussed below. In summary, it would seem plausible that the application of complex simulator trainers will not be flooding our occupational education areas for some time. Yet, simpler systems such as the one described above, should find wide acceptance in many areas.

The Pocket Blinker

Lest the reader get the mistaken idea that the lower the cost, the more limited the simulator, let us examine an ingenious little device that costs about ten cents. It's called a pocket blinker, and certainly meets all of the requisites to be classified as a simulator (U.S. Naval Training Device Center, 1963). The device is cardboard, and simulates the operation

of a ship's blinker. Two seamen, sitting across a table from each other, may practice sending Morse Code messages back and forth using two of these little devices. They are so constructed that hand pressure moves a sliding cardboard in and out of a slot, thus simulating the alternate black and white patterns emanating from a ship's blinker light.

Implication for educators. In a remarkable way, the pocket blinker illustrates the fact that simulation exercises or devices do not have to be expensive to be effective. As long as the educational objective is consistent with the operations demanded by the exercise, low-fidelity, low-cost devices are eminently satisfactory. Even if the objective for a seaman learning Morse Code is to have him identify patterns under adverse conditions such as bad weather or combat, variation in the way the pocket blinker is used could provide such training. However, for educational objectives that simply reflect the learning of the Morse Code and identifying visually Morse Code patterns, the pocket blinker used in the simplest circumstances is a suitable simulation exercise. Low fidelity, in this case, does not sacrifice learning effectiveness and efficiency. Similarly, simulation exercises and devices do not have to be expensive in school settings.

Unfortunately, simulation designers, for the most part, have not been able to specify when exact physical duplication of the real-life situation is necessary to guarantee maximum transfer in the real-life (operational) situation. The research literature does not have a precise answer to this question. Some studies on transfer of training show that the more similar the two situations are, the more transfer will occur from the first situation to the second situation. On the

basis of these studies, many designers are prone to develop what are called "high-fidelity simulations," some of which are so complex that entire teams of operators are required to monitor the experience. On the other hand, many studies have presented evidence to indicate that for complex skills, greater transfer is produced by a systematic arrangement of practice than by high-fidelity physical simulation (Gagne, 1962; Cox, et al., 1963; Gryde, 1966; Crawford, 1962; Smode, 1963; Newton, 1959).

War Wound Moulage Kit

Before leaving the military applications of simulation, it would be well to examine one more simulation device that represents relatively high fidelity but low cost -- the War Wound Moulage Kit (Woolley, 1956). The wound moulage serves two principal purposes: (1) it enables the wearer to apply first-aid treatment to himself, witnessed by students for a first-hand demonstration of proper first-aid procedures, and (2) it enables the wearer to be placed in the field as a casualty, enabling students to perform first-aid measures under simulated battle conditions. Let us examine the latter of these two purposes. Place yourself in the position of a squad leader, walking through the woods. It is a hot day, and around you is the sound of war - artillery, grenades, rifle fire. This is a full scale, simulated, battle maneuver. You hear a call for help. Over to the left, a man lies wounded. You rush to him, and apply first aid. Bleeding stops.

The wound that you "treated" was simulated. Yet, the situation called for real-life operations that sometime could save a man's life.

The wound moulage consists of a thin flexible, flesh-colored overlay which simulates as closely as possible actual wounds in pertinent adjacent areas of the human anatomy. Each individual moulage is full size, depicts all of the characteristics of a wound, including details such as torn flesh, broken bone, severed veins and arteries, and even blood flow. Bone structure and flesh are shown in relief on the surface of the moulage. Each moulage is capable of being attached to the appropriate area of the wearer's body, and is readily removable without the use of tools. Included in the kit is a veinous puncture moulage and a hypodermic-needle insertion moulage to train students in withdrawing blood and injecting medication into the body. The kit contains 20 moulages, several of which are mentioned below:

(1) Gun shot wound of the palm of the hand;

(2) Phosphor burns of the hands;

(3) Second and third degree burns of the forearm;

(4) Compound fracture of the lower leg

(5) Amputation.

Implications for education. This particular technique of simulating wounds certainly should not be reserved for the military. What better way is there to train students of all ages how to handle first-aid emergencies. This writer knows of several hospitals which are using similar techniques to train nursing students, and has heard of the application for training first-aid measures for Boy Scouts. Indeed, this relatively low-cost, high-fidelity simulation could have application in such areas as police training, medical and paramedical education, firemen training, and the like. Again, what is important is not so

much the realism of the simulation as it is the operations that the student goes through in performing the simulation experience. The War Wound Moulage kit engages the student in performing adequate first-aid measures under pressure, and is so designed that the transfer to real life is maximal. Even blood flow must be stopped by using the appropriate amount of pressure at the appropriate location if the patient were actually wounded.

A cursory examination of each of the four simulation applications described above--the simulator trainer, the low-cost autoinstructional simulator, the pocket blinker and the wound moulage -- reveals that they share in common the feature of being media-or machine-ascendent. This is, each uses some mediating device to provide an opportunity for practice or exercise of various crucial skills. It goes without saying that complex decision-making or identification skills are probably best trained by exercising these behaviors in a life-like setting where the learner may receive immediate feedback as to the adequacy of his response. Civilian applications of media-oriented simulation are becoming increasingly familar in higher education. An example is found in the unique application of simulation in teacher education as developed at Teaching Research (Kersh, 1961; 1963a; 1963b; Twelker, 1967). Classroom simulation creates for the student teacher many of the relevant features of a single classroom situation called "Mr. Lands' Sixth Grade." Mr. Land is the hypothetical supervising teacher with whom the student teachers work during this simulated experience. A complete cumulative record file is available on each child in addition to printed descriptions

of the hypothetical school and community. The technique of filming the youngsters in the simulated class so that they appear to be reacting to the student teacher during the sequences is employed in sixty different problem sequences on sound, motion-picture film. In each case, the student teacher is expected to react to the film as though he were in a real classroom. Classroom simulation is based on the supposition that exposition of educational methods or principles could be expected to help the teacher talk about teaching, but only classroom experience (simulated or real) could train the beginning teacher to teach. It has been suggested that classroom simulation in this form helps students practice the discriminating of cues that signal potential problems that require immediate attention, make decisions in simulated conditions without fear of censure or embarrassment, and to modify their behavior on the basis of this feedback. (Twelker, 1967).

Other examples of media-oriented simulations developed for higher education include Cruckshank's work in classroom simulation and inner city teaching problems (Cruckshank, 1966), simulation of dental emergencies (Jarabak, 1966; Lund, 1965; 1966), and audio simulation for counselor education (Beaird and Standish, 1964; Beaird, 1966). It is simply a matter of time before other applications are made in school settings of media-oriented simulation to create a realistic practice setting.

Governmental Applications

To this point, little has been said of the application of simulation in settings that do not involve instruction. In the discussion of governmental applications of simulation it might be profitable to examine

the use of the human-player simulation exercise for the analysis and planning of complex programs or systems.

Planning Exercises

Typically, the planning of programs that involve complex situations where numerous points of view may be brought to bear takes place in rather sterile environments that do not allow the planners to use creativity and experience to detect unforseen difficulties, develop new strategies, and examine their effect on the proposed system or program. Sitting around a conference table may not always promote the kind of social interchange that is conducive to good analysis and planning. A special use of the simulation exercise normally reserved for instruction, offers a great potential for educational planning. For purposes of this discussion it may be referred to simply as a planning exercise. Planning exercises have found use in city planning, architecture, and urban development (Taylor, 1967; Taylor and Maddison, 1967, 1968; Feldt, 1966, 1967). Strategies for military efforts have been developed using war games. It is only natural that the application of the simulation exercise to planning be exploited elsewhere.

The planning exercise to be described for purposes of illustration was conducted for the exercise and evaluation of national-level civil defense systems within the context of realistic changes in international tension and crisis buildups (Hardick et al., 1967). The exercise portrayed an environment that simulated the world in which the Office of Civil Defense (OCD) exists so that its functions and operations could be introduced into that environment for purposes of analysis and evaluation.

The game allows the OCD to:

(1) identify problem areas and alternative courses of action, given the initial situation;

(2) obtain information for further study and analysis;

(3) investigate alternatives and problem areas by actually "playing" them out;

(4) identify future possible contingencies, important operative factors, and probable outcomes that may be overlooked in OCD planning;

(5) Stockpile useful conclusions from various plays and recycles of the game;

(6) test probable impact of changes in OCD systems;

(7) identify weak links in OCD and other governmental agencies;

(8) provide "analytical guideposts" for future studies; and

(9) evauate the impact of the exegencies of time and events on the OCD decision-making process.

In its simplest form, the game involves two sides:

(1) the United States, represented by the Blue National Team and the Office of Civil Defense (OCD) Team; and

(2) the enemy, represented by the Red National Team.

The OCD Team operates separately as a subordinate staff agency of the Blue Team, and furnishes the Blue Team with status reports on civil defense activities, advises on civil defense matters, and converts Blue civil defense decisions into plans and orders. In a more complex form, the game may involve other nations.

A basic scenario provides the framework and background against which plans and decisions are made by the participants. In brief, it provides the setting for the initiation of game play. Factual data present general and special international situations to provide a view of the world conflict areas. Summaries are given to each team describing their national political and economic posture, their resources, national goals, and so forth. In addition, separate intelligence reports defining enemy capabilities, limitations, and resources are provided.

Once the basic scenario is used to project the world situation to the starting point of the game, player actions largely determine subsequent events and world conditions. A "control" is used to guide the game so it does not drift into irrelevant channels that do not meet the game objectives The main feature in the game play is the "estimate of the situation" prepared by each team. These represent plans or actions derived from logical analysis of the events, and provide a basis for succeeding cycles of play when these plans and actions are implemented to generate international tension that precipitates a crisis. "Control" assesses the estimates to determine their relevance to game objectives, and their validity with respect to diplomatic, political, and military strategies. Succeeding cycles provide players an opportunity to implement the actions projected in their initial estimate, to analyze new situations, to develop alternative plans to meet the simulated conditions, and to make further decisions regarding their course of action to take.

Side studies may be used to examine in detail significant facets of a civil defense situation not amenable to full development during the exercise. Another important feature of the exercise is the capability to

retrace the path of the game and to replay it from any desired point in order to investigate alternative strategies.

The post-game evaluation is a crucial part of the planning exercise. The game is reviewed to broaden the overview of all players and to provide the opportunity for cross fertilication of ideas. It may be decided to replay specified situations or to conduct side studies when required.

Implications for Education

The sort of exercise described above has been used in planning educational systems. Abt (1967) calls the technique a "human-player simulation of the planning, programming, and budgeting process."

Typically, the planning exercises developed by Clark Abt and Associates usually run for at least a day or two and involve as many as fifty or sixty participants. Simply stated, the exercise is "designed to force planners to interact with one another over critical school issues and to gain from the feedback, critical insight into the problems of educational planning and the possibilities for solution" (Abt Associates, Inc., 1968, p. 7).

Three variations of the planning exercises have been described in detail elsewhere: The Educational System Planning Game (Abt, 1967); the PEPEX Educational Planning Simulation (Abt Associates, Inc., 1968); and SEPEX - A School Electronics Planning Exercise (Abt Associates, Inc., 1967. The Educational System Planning Game involves the participants in a game situation where major issues of education planning, their benefits and their costs, are brought into the open and discussed. Players take the roles of educators, students, and a special type of person - the

"Reality Daemon" whose function it is to personify various social problems and pressure groups related to educational planning such as industry, the disadvantaged, the minority groups, parent groups, and so forth. Depending on the number of players, there may be two or more teams composed of these three groups. The game exercises Educator Teams in their educational-system planning skills, and Student and Reality Daemon teams in their education-evaluative skills as well as the identification of crucial issues. The Educator Team that prepares the best program, perhaps measured by the quantity and quality of graduates, with the given budget, wins.

The sequence of activities may be summarized as follows:

(1) The Educator teams formulate policy while the Student teams prepare evaluative criteria for estimating the Educator's programs. The Reality Daemons input to both Teams.

(2) The Educator teams submit their reports for Student team evaluation and selection

(3) The Reality Daemons make adjustments for implausible claims, and score the evaluations.

To be sure, the plans produced in a few hours' deliberation are much too broad to be directly useful. Yet, it seems evident from this writer's experience with the planning game that successive cycles of play, perhaps separated by information-generating activities, may be a very real asset to the planning of education systems. In a realistic and intense way, issues are brought to light, and various strategies of meeting these issues are proposed and evaluated. The interpersonal

communications that are elicited in the simulation environment seem to have a facilitative effect in focusing the problem and bringing to light tentative solutions, much more so than in a discussion of the same problems around a conference table. An added bonus is that the exercise is readily adapted to practically any educational group's needs, and little is required in the way of special facilities or equipment.

It remains to be seen whether the planning exercise actually does result in better program plans consistently as compared with conventional techniques. Evidence in the published reports indicate that local conditions or inadequacies in previous plays lead to changes in the exercise that may or may not represent improvements. Game design questions need to be resolved: How complete should the briefing be, in terms of school district data and information; how precise should roles be defined; how much time should be given for the various activities; what terminal objective should be stressed (prepare a finished plan vs. state problems and suggest solutions); how much game structure should be used; how many issues should be predesigned into the game; how much role-assuming vs. role-performing behaviors should be used, i.e., should superintendents perform their own role, or another's role; etc.

In summary, it seems that the planning exercise offers some exciting alternatives for constructing programs in the field of education. It potential has not been realized. It has even been suggested that "ultimately, a planning exercise should be used to assist planners in building predictive models of the educational systems for which they are planning" (Abt Associates, Inc., 1968). This use of simulation should receive much greater attention, both in application and research, in the next few years.

Industrial Applications

Many industries and businesses have grown so rapidly in the last decade that training programs for their employees are practically mandatory. Personnel shortages in some areas are acute. Management has recognized the need for having training programs in order to retain talent as well as to upgrade talent.

Typically, these programs initially emulate conventional programs found in public education. The immediate problem that faces the vice-president in charge of training is that when managers, employees, and businessmen return to the classes, the last thing they want are seminars and lectures on fundamental principles and concepts isolated from a functional context. This problem is easily overcome with the use of simulation in the form of the business or management game.

Business games have historical roots dating back to war games and military map exercises (Thomas, 1961). In the typical military game, two teams given hypothetical missions attempt to accomplish their goals by alternately making decisions, having them evaluated by umpires, and making further decisions on the basis of the umpires feedback. Often, computers are used to calculate the decisions.

The first practical game for business management was developed in 1957 by the American Management Association. The Top Management Decision Simulation is now one of hundreds of games that simulate the decision-making process of management in various settings ranging from supermarkets to unspecified industries. These games exercise all aspects of management including production, marketing, and inventory control. While many of the games are used in colleges, a wide variety are used in industry, for

example, to help employees practice making decisions in business so as to better understand business operation. Such a business simulation exercise is Venture, developed by the Proctor and Gamble Company (Proctor and Gamble, 1966). In Venture, one or more participants manage cooperatively one of five companies, competing in a single consumer products industry. The exercise involves each company in making decisions about such things as production, costs, research, and marketing, during an "operations meeting" and profit allocation during the "profits meeting". Scorers calculate manually the results of each company's decisions after each meeting.

Results are shown in terms of product sales, sales income and gross profit. After the six-period operation, a critique is conducted where participants review their objectives, decisions, and results.

Venture is geared more for the orientation of company employees to business operations than for the training of top management. The Proctor and Gamble Company has found it profitable to have employees learn more about what business management does. It should be noted that only selected parts of the industry are simulated. Not included are provisions for borrowing capital, for example. The omission reduces complexity as well as "serves as a constructive discipline toward participants' good management of existing resources." Other management simulations are geared for executives. Whatever audience is targeted, the game is basically similar to the one described, in terms of the decisions required.

Implications for Education

Basically, the business game is a "trial-and-error method used to gain insight into business problems" (Greene, 1960). It may be used at the beginning of a training program to orient or sensitize students, or it may be used at the end of the course as a self-evaluative instrument. It can be played over a prolonged period of time, or in a matter of hours. It may even be played by mail. Greene (1960) reports of a large oil company those men in the field report decisions, and review feedback by mail.

It need not be pointed out that the simulation game may be applied in education. It is being applied. Literally hundreds of games are being used, and have been used in past years with little public recognition. Its use, in fact, has some of the characteristics of a fad. Many instructors are experimenting with the simulation game with little or no guidance offered by the game designers. On the surface, it seems obvious that the game does possess enormous potential when properly applied. It involves most students actively where other techniques fail. Most users point out that the novelty and the excitement created by simulation are unparalleled in most educational circles. Cherryholmes (1966), in his review of six investigations of educational games, concluded that simulation produced increased student interest.

There are those who state that games have severe limitations, and are probably overused. Several years ago, the same type of criticism was given of business games (cf., Roberts, 1962). Now its the educational game's turn to be criticized, and these criticisms are not entirely unfounded. There are weakness in business and educational games,

and their administration. Realism of the game, and ability of the game administrator are areas where faults occur. It almost seems that the production of games with built-in shortcomings exceeds research on how games may be improved. Game design is either looked upon as exceedingly complicated, and difficult for layman to understand, or it is a task handed over to the students themselves. Some point to this latter case as being the strongest asset of a game. When students design games, they learn about the model and how various components interrelate with each other. It's difficult to justify the building of elaborate guidelines for game design by the instructor when it is proposed that games be designed by the students themselves. Yet, youngsters may have more insight on the "whys" of student designed games than the instructors who design games for them. When asked whether he learned more from moving pictures or learning games, one junior-high schooler quickly replied, "Movies. They teach you something. Games are just for fun." Perhaps game designers have been too concerned with only the cognitive outcomes of the so-called <u>learning</u> games. Perhaps on occasion they should settle for affective outcomes that simply keep the potential learning drop-out in the system. If a game did just this, it would be worth while.

Television-Mediated Simulation

Simulation need not be limited to a trainer, a classroom, or a series of rooms in which students interact in teams. One of the most unique experiments involving simulation used home audiences of WGBX-TV, a special service UHF channel in Boston (Lee, 1967; 1968). In the fall of 1967 a 5-program simulation game, called The Most Dangerous Game was broadcast. It was a fictional-name simulation of the Korean crisis of 1950. Studio participants represented statesmen of six major nations involved in the simulated dispute. The home audience took the part of the political elite of one of the teams. They advised the statesmen through telephone calls and letters. Further, home viewers interacted with each other and discussed issues raised in the simulation.

Roger G. Mastrude of the Foreign Policy Association, with whose cooperation the series was developed, summarizes the goals of the experiment.

> "(1) to enlist a new participating audience not enlisted through proper community-organizing efforts;
>
> (2) to motivate a relatively large audience of intelligent television viewers sufficiently to: (a) induce them to view a world affairs program, and (b) induce them to act as participants in simulation by interpersonal discussion and/or by telephone to the station;
>
> (3) to reshape simulation into a visual medium (for its normal character as a process wholly constructed for the experience of the players who enact it);

(4) to construct a learning-situation fruitfully combining the 'media' of the simulation exercise, television, discussion, and telephone feedback;

(5) to communicate substantive lessons with important educational value for this audience."

(Lee, 1967, pp. 11-12)

The results of the experiment have been reported in detail elsewhere (Lee, 1967). For purpose of this discussion, it is sufficient to note that audience response was overwhelming. By far the most appealing aspect of the program reported by home viewers was "audience participation." Sixty-nine per cent of the audience called the station more than once on the last program. It is also interesting to note that the majority of viewers watched the program (or more accurately, participated in the simulation) as family groups or with informal groups.

Implication for education. This unique experiment represents a most significant wedding of a technique with a medium. There is little doubt the success of The Most Dangerous Game will not be forgotten. It revealed that television audiences need not be passive receptors. The exeriment dramatically illustrated how television can involve home viewers.

In the experiment, the home audience played the role of advisors to one studio team. Clearly, this limitation did not reduce home participation involvement. However, the home participants need not be limited to an advisory role for only one team. Lee (1968) suggests that the simulation might be played in several cities, each city representing a country. Through a flexible interconnected network system, cities

could break away from the interconnection and broadcast locally to only its own constituents. This, in fact, has now been done.[3] Cabinets in Crisis, a simulation involving the 1950 Yugoslau crisis with Russia, was played in the Spring of 1968 in three cities-- Boston, Philadelphia, and Rochester, New York. The studio audience took roles of executives while the home audience acted as the legislature who sent back replies to the executives to try to influence them. It was played for one day per week for five weeks. This same game has also been played with English speaking high school students in Singapore, Kenya, and Chicago.

The use of television as a medium for simulation need not be limited to international relations and world affairs. What better use could be made to involve all parts of society in an examination of urban problems, civil rights, and educational and local issues. For example, in an examination of poverty, could home viewers develop empathy with real-life counterparts in such a manner that their behavior would be permanently changed? Since television is so universally watched and enjoyed, the implications of using television, not as an information-imparter, but as a response eliciter, are staggering. What better way is there to unite a family for an evening in a school-related simulation in U. S. History, civics, or social problems. Simulation exercises need not be limited to class hours in a school room. The day might even come when periodic simulation specials are conducted over networks in prime time spots.

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[3]Personal communication with Mr. George McClelland, Foreign Policy Association.

Situational Response Testing

In designing the form of a test, an individual has a number of possibilities available to him, such as:

(1) elicit a related behavior that must be inferred on the basis of logical relations;

(2) elicit "what I would do" behavior, where the student states what action he would take to solve a problem, given a brief description of a problem situation;

(3) elicit lifelike behavior, where the student gives lifelike responses in non-real-life (simulated) settings; and

(4) observe real-life behavior.

These and others are discussed in detail by Frederikseen, (1962, pp. 323-346).

Frederikson states that the "observation of real-life behavior is ordinarily not a suitable technique for measurement." (Nor is it usually practical, especially with large groups of learners.) Frederikson claims that the measure that is "recommended for just consideration in a training evaluation study is the type that most closely approximates the real-life situation."

For illustration, let us examine the work of the American Board of Orthopaedic Surgery, who has revolutionized its in-training examination with a procedure that simulates the physician-patient encounter (University of Illinois, 1967a). The Patient Management Problem test has several unique features:

(1) it presents a simulation problem in patient management that carries the examinee through a series of sequential,

interdependent decisions representing various stages in the diagnostic work-up and management of a patient;

(2) it provides realistic feedback about the results of each decision as a basis for subsequent action, and does not allow the examinee to retract his decision once it is made; and

(3) it allows both for variations in medical approaches and in patient responses appropriate to these several approaches.

The procedure may be best illustrated by going through one of the problems. For example, one case involves a 62-year old woman who fell and fractured her hip. A mild cardiac failure was detected and controlled. The examinee is now asked to specify treatment of the fracture. Pictures of the fracture are provided. First of all, the examinee is asked to choose among six alternatives. Should he: (1) initiate non-operative therapy; (2) perform a closed reduction and internal fixation; (3) perform a closed reduction, valgus osteotomy and fixation; (4) perform an open reduction and internal fixation; (5) insert a prosthetic replacement; and (6) remove the femoral head and neck. The examinee indicates his choice by erasing an opaque overlay on an answer sheet to the right of the corresponding number of the choice. Suppose he chooses "to perform a closed reduction and internal fixation" and erases the overlay next to #370. He is directed to "Erase Response 445" which reads:

"After two attempts at reduction, X-rays were obtained. (Figures 5 and 6.) Turn to Section IIIE."

Section III E asks the examinee if this is an acceptable or unacceptable reduction, on the basis of the X-rays. If he says that it is acceptable,

he erases the overlay next to #397 and is directed to "Erase Response 447."

"You have now fixed the fragments and the patient has done well on your immediate post-operative regime. She has returned after two months complaining of pain in the groin. Upon examination the pain increases when the hip is moved in any direction. Turn to Section III A."

Section III A asks what the examinee suspects is wrong. Suppose he hypothesizes that loss of position is the cause of the pain. Erasing the #377 overlay reveals that #450 should be erased. It reads

"You order an X-ray (Fig. 13) to confirm your suspicion. Turn to Section III 1)."

Section III D asks the examinee to advise one of several solutions. If he chooses full weight bearing as the treatment, he is asked to erase #389 and #457 consecutively, and reads:

"In six weeks you receive a letter from another orthopaedic surgeon stating that the patient had consulted him because she had severe pain. He found that the femoral head had separated from the femoral neck and he is doing indicated reconstructive surgery. END OF PROBLEM."

It is apparent that an unwise decision a few moves back had led our future orthopaedic surgeon to strike out. The treatment of full weight bearing has caused further problems resulting in reconstructive surgery. His score for this problem is figured by noting the number of errors at failing to select helpful options as compared with the

number of errors of selecting harmful or ineffective options. Also, his score could be expressed in terms of per cent agreement with the experts.

Other examinations employing simulation techniques that have been developed for the evaluation of performance in medicine include simulated diagnostic interviews, simulated proposed treatment interviews and simulated patient management conferences (Levine and McGuire, 1968; McGuire, 1968; University of Illinois, 1967a; 1967b). These techniques all use role-playing techniques, where an examiner is "programed" to play the role of a patient.

Implications for Education

A most urgent need in educational systems is for the criteria test that is given after instruction to accurately reflect the objectives of instruction. It is all too obvious that one cannot specify the appropriate techniques for evaluating instructional outcomes until he has a clear idea of what these outcomes are. During the last decade, the emphasis on stating objectives in a way that is at least related to observable behavior has given impetus to the designing of tests that better assess terminal performance on the part of the student.

In his discussion of situational response tests, Frederiksen uses as examples the Medical History test used by some medical schools, the In-Basket Test, used in school administration courses, the Russell Sage Social Relations Test, used to evaluate elementary schools with respect to their success in teaching "social relations," and the Physical Science

Study Committee Physics Test, for high school physics courses. It will be noted that there is more than a passing resemblance of this technique with the Trainer-Tester Simulator discussed above. Both involve an ingenious method of sequencing a number of interdependent decision-points in a realistic manner so that the cognitive skills of decision making are exercised or tested. The potential for application in professional education courses, adult education, as well as in public schools is practically unrealized. The use of simulation for performance evaluation is discussed further by Gagne (1954; 1962), Thorndike (1947), Gibson (1947), Schalock, et al. (1964), and Beaird (1967).

Summary

From the examination of the several applications discussed above, it is probably safe to say that simulation is "coming of age". The "innovation" of simulation is not new to education, at least non-public education. Simulation has been around for years--in the military, industry, and more recently, government. Simulation does not really represent a startling new approach that out-modes all others. It does represent a new way of looking at instruction that emphasizes the judicious approximation of aspects of real life to create an environment for life-like response on the part of the student.

How does one assess the status of the field? By the quantity of simulations being developed? By the quality of these products? By its wide range of application? This report does not purport to offer evidence to determine accurately any of these factors. It is difficult to even estimate how many different simulation exercises have been developed for

instructional uses. This writer estimates that minimally, 300 simulations have been developed, and disseminated in one form or another, primarily for school use. Probably this number is much higher. It is also difficult to assess the quality of these simulations, since objectives are not clearly stated in many cases. It is somewhat easier to assess the variety of the application. One only need witness the applications briefly alluded to in this paper to see its wide use. Slowly, data are being accumulated to show the learning functions most appropriately developed by simulation techniques. In the next ten years, what will be learned about simulation will establish a firm data base to guide the development and use of the technique in well-founded ways.

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APPENDIX

Uses of Instructional Simulation Systems in Industry, Government the Military and Other Non-School Settings

Not all instructional simulation systems are used in public- or private-school settings. Many are used in the military, government, industry, and science. The simulation systems listed below are representative of these non-school, instructional uses.

GOVERNMENTAL APPLICATIONS

Simulation	Designer	Target Group	Description
Agile-Coin	Abt Associates Inc., Cambridge, Mass.	Advanced Research Projects Agency	This game focuses on important political and operational factors in the transition from the terrorism phase to the guerilla warfare phase of insurgency. The objective of the game is to observe the effects of coercion and counter-coercion on village loyalty.
Forest Fire Simulation	International Electric Coporation Paramus, New Jersey	Division of Fire Control of the Forest Service, Dept. of Ag.	The Forest Fire Simulation is designed to provide training in a realistic stress condition associated with campaign fire management.

Simulation	Designer	Target Group	Description
Corridor	Abt Associates Inc., Cambridge, Mass.	U.S. Department of Commerce, Northeast Corridor Project	The simulation exercises political and economics factors which come into play in the formulation and implementation of regional transportation policy for an extended area.
Federal Market Place	Information Resources Inc.	Higher Education; Administrative Personnel	Federal Market Place is designed to provide a simulated social environment in which people can learn about the process of Federal assistance for higher education.
National Level Civil Defense	Technical Operations Inc. System Science Division Arlington, Virginia	Office of Civil Defense	This simulation is designed to provide gaming experience for exercising and evaluating Civil Defense systems. The simulation is exercised within the context of realistic and credible changes in international tensions and crisis.
Office of Industrial Development (OID) Management Sim. Exercise	State of California Resources Agency	Department of Water Resources, State of California	Simulation exercise for training Department of Water Resources personnel in various management and administration problems.
PESO	Abt Associates Inc. Cambridge, Mass.	Inter-American Development Bank	The game is designed to show officials from Latin American countries how to present requests for financing development projects. Trainees play lending officers in the institutions and ministers representing the economic sectors in need of financing.
Police Training	Abt Associates Inc. Cambridge, Mass.	Law Enforcement Officers	The game is used to demonstrate that the relation between law enforcement officers and the community is not competitive but cooperative.

Simulation	Designer	Target Group	Description
Politica	Abt Associates Inc. Cambridge, Mass.	Advanced Research Project Agency	This game is designed to simulate the economic and political functioning of a nation by attempting to structure the roles of major interacting national groups, to place them in conflict of cooperation, and to identify from the resulting interaction the societal and human variables relevant to a study of incipient insurgency.
Polwar	Abt Associates	Foreign Service	This game is designed to present some of the political and economic factors present at the Village level in the current phase of the Viet Nam situation. It specifically focuses on the operation of the Vietnamese Revolutionary Development Program.
Region	Washington Center for Metropolitan Studies Washington, D.C.	Urban planners	This game simulates the growth of metropolitan areas and incorporates some of the theories of economics, political science, and sociology. The game consists of two regions: Region I is a simplified version of an urban area and Region II represents a highly complex group of urban systems.
Shelter Management Contingency Game	Social Systems Program, American Institutes for Research	Office of Civil Defense, Shelter Management Instructors	Presents complexities of problems found in the management of a large shelter.
Simpolis	Abt Associates Inc. Cambridge, Mass.	Design-In	Simpolis is an encounter with seven major urban problems of transportation, education, housing, civil rights, poverty, crime, and pollution. The aim is to communicate the essense of the problems and elicit possible solutions to and consequences of the various problems.

Simulation	Designer	Target Group	Description
Virgin Islands	Abt Associates Inc. Cambridge, Mass.	College of the Virgin Islands	This simulation is designed to demonstrate and clarify social communications problems in St. Thomas, while showing opportunities for improving this communication among Island groups.
Urbcoin	Abt Associates Inc. Cambridge, Mass.	Advanced Research Projects Agency	The game exercises a number of factors important in situations of urban insurgency. The players interact in terms of population on "lives" so that terror can be simulated and also in terms of "money" so that economic disruption is possible.

INDUSTRIAL APPLICATIONS

ADMAN	Abt Associates Inc. Cambridge, Mass.	American Institute of Banking	This game describes problems faced by bankers in allocating advertising expenditures. The object is to acquaint bankers with advertising.
Drivocator System	Aetna Life and Casualty Company	Greyhound Corp; Air Force; Public Schools	The Drivocator is a programmed simulation of actual situations which drivers may be faced with under normal driving conditions. The students are asked to respond to these situations by choosing the most logical course to follow.
Bank Loan	Abt Associates Inc. Cambridge, Mass.	Banks	This game was developed to demonstrate management training in the making of loans.

Simulation	Designer	Target Group	Description
Bristol	Abt Associates Inc. Cambridge, Mass.	Bristol Laboratories, Division of Bristol-Meyers	This game is designed to familiarize district and regional managers with marketing strategy and marketing division operations.
Capital Budgeting	Abt Associates Inc. Cambridge, Mass.	Price Waterhouse & Co.	The game provides a situation in which players can use such investment techniques as discounted cash flow, pay-back, and return on investment. The game also provides players with the circumstances where these techniques may be properly applied.
Fast	Abt Associates Inc. Cambridge, Mass.	U.S. Trust Co.	The game designed to explain to new trainees how the U.S. Trust Co. functions to attain basic corporate goals. The game demonstrates how interpersonal coordination is necessary in analysis, communications, planning, etc., to accomplish basic functions of the corporation.
IFMA	Abt Associates Inc. Cambridge, Mass.	International Food Manufactueres Association	This game consists of three parts, each dealing with an area of specific interest to the food service industry. Part I concerns organizational development; Part II deals with selling national accounts and related distribution problems; Part III concerns mergers and acquisitions.
Purdue Dairy Management Game	E.M. Babb and L.M. Eisgruben	Industry and Schools	The game simulates the environment of competition in which two to four dairies are processing and marketing fluid mild products.

Simulation	Designer	Target Group	Description
Purdue Farm Management Game	E.M. Babb and L.M. Eisgruben	Industry and Schools	This game simulates the environment in which a farm business must operate. Success depends on the correct combination of products to be produced, the correct method of production, and adjustment to changing conditions.
Purdue Farm Supply Business Game	E.M. Babb and L.M. Eisgruben	Industry and Schools	This game is designed to duplicate the problems of the farm supply business. Managers must make operational decisions which are dependent upon available storage space, inventory, and anticipated sales with regard to competitors.
Purdue Supermarket Management Game	E.M. Babb and L.M. Eisgruben	National Assoc. of Retail Grocers of the United States.	This game simulates the environment in which supermarkets must operate. The managers gain experience in using business planning, analytical tools and economic and accounting principles.
Settle or Strike	Abt Associates Inc. Cambridge, Mass.	Communication Workers of America	This game is designed to be a collective bargaining game for Union leaders of small shops to introduce them to the collective bargaining process.
Small Business Executive Decision Simulation	Bureau of Business Research, University of Texas	Small Business Administration	This simulation is designed to portray the competitive and operational environment confronting a small manufacturer. The manufacturer must make rational decisions concerning pricing, output, borrowing, and purchasing.
Super A, Super B	Abt Associates Inc. Cambridge, Mass.	Supermarket Institute	Super A is designed to teach supermarket buyers scientific buying techniques. Super B teaches supermarket executives how to make better decisions on trading stamps, introduction of soft goods, leasing of property and civil rights.

Simulation	Designer	Target Group	Description
Travelers Management Decision Game	The Travelers Insurance Co.	The Management Conference	This game simulates the operations of four insurance companies for a period of seven years. Decisions must be made relative to allocation of available funds, underwriting and maintaining margin of net profit.
UCLA Executive Game	Richard C. Henshaw James R. Jackson	Industry and Schools	The game simulates the various decision-making problems faced by executives in business. It covers the areas of production, marketing, finance, competition, etc.
Venture	Proctor & Gamble Co. Cincinnati, Ohio	Proctor and Gamble Co. personnel; Schools	Venture is a business simulation exercise designed to help develop a better understanding of how business corporations function. The players are introduced to the problems of conceiving, manufacturing, and marketing products.
MILITARY APPLICATIONS			
Autospan	Human Resources Research Office George Washington University	Army	Autospan provides for learning a foreign language via autcmated programmed instruction with a simulated tutor.
Caisim	U.S. Army Logistics Management Center	Army	This simulation concerns several management problems involved in industrial manufacturing. The setting for the problem is the U.S. Army Arsenal with the mission of manufacturing the 107 MM Recoilless Rifle.
Calogsim	U.S. Army Logistics Management Center Fort Lee, Virginia	Military and civilian Logistics Personnel	This simulation is designed to utilize "selective management" and "management by exception" techniques in the hypothetical setting of the U.S. Defense Department wholesale supply system. The students are trained in the use of a logistics simulation at the wholesale level.

Simulation	Designer	Target Group	Description
Capertism	U.S. Army Logistics Center, Ft. Lee, Vir.	Army	Capertism is based on the technique known as PERT (Program Evaluation Review Technique) and simulates management of a project in which inter related activities to must be accomplished for the attainment of the objective end.
Cross-Cultural Communication Simulation	Human Resources Research Office	Military	This simulation is designed as a demonstration of cognitive American behaviors as reflected by six cross-cultural encounters with a foreigner.
Monopologs	The Rand Corp. Santa Monica, Calif.	Air Force	This simulation is designed to introduce players to the Air Force Supply System. The players practice inventory management and gain insight into inventory control problems.
Pocket Blinker	U.S. Naval Training Device Center	Navy	The Pocket Blinker is designed to simulate the signal device used by the Navy in transmitting messages from ship to ship.
Simulation Trainers	U.S. Naval Training Device Center, and other groups.	Military Personnel	Simulation trainers, which number over 3000, are designed to train military personnel in various techniques involving man-machine adaptive and responsive environments. Some representative types are the: Submarine Simulator, Universal; Helicopter Flight Simulation; Fire Control and Launcher Simulation; F8U-1 Operational Flight Simulator Trainer; and the Height-Finder Target Simulation.
Trainer-Tester Simulators	Van Valkenburgh, & Neville, Inc. New York, N.Y.	Military	The trainer-testers are designed to simulate actual mechanical problems involved in the use of various technical equipment. The user is able to trouble-shoot, on paper, problems involved in radar systems, a six-cylinder motor, and other electronic devices.

Simulation	Designer	Target Group	Description
War Wound	U.S. Naval Training Device Center	Military Personnel	The moulages kit is designed to simulate in-battle emergencies by the use of plastic overlays. These overlays simulate torn flesh, broken bones, severed veins and arteries, and blood flow.
MISCELLANEOUS APPLICATIONS			
EDPLAN	Abt Associates Inc. Cambridge, Mass.	Educators	This game is an education system planning game designed to illuminate some of the major issues in education planning; to excite an awareness in alternative plans, cost benefits problems, and other diverse approaches to education.
Community Response (Disaster)	John Hopkins Univ.	4-H Clubs; Schools	This game simulates a community hit by a localized natural disaster. The problem is whether to dispel personal anxiety by locating all family members or to respond for the good of the community.
Orthopaedic Surgery Simulation Test	Univ. of Illinois College of Medicine with the American Board of Orthopaedic Surgery	American Board of Orthopaedic Surgery	The Orthopaedic Surgery Simulation presents a problem in patient management that carries the examinee through a series of sequential, interdependent decisions representing various stages in the diagnostic work-up and management of a patient.
PEPEX	Abt Associates Inc. Cambridge, Mass.	Operation PEP Burlingame, California	PEPEX is designed to give participants experience in the process of educational planning. PEPEX employs the use of a cost-effectiveness model and also gives experience in deciding upon alternatives to planning.

Simulation	Designer	Target Group	Description
SEPEX	Abt Associates Inc. Cambridge, Mass.	Central Michigan Education Research Council	SEPEX is designed to involve educational decision-makers in the process of planning applications of electronic systems to instructional and administrative educational services.
The Most Dangerous Game	Abt Associates Inc. Cambridge, Mass. with the Foreign Policy Association	Home TV Audiences	The Most Dangerous Game was designed to simulate the Korean Crisis of 1950. The game was played over television with the audience assuming certain roles.